

UNITED STATES DISTRICT COURT  
DISTRICT OF MASSACHUSETTS

SINGULAR COMPUTING LLC, )  
)  
Plaintiff ) Civil Action  
)  
) No. 19-12551-FDS  
vs. )  
)  
GOOGLE LLC, )  
Defendant )

BEFORE: CHIEF JUDGE F. DENNIS SAYLOR, IV

MARKMAN HEARING CONDUCTED BY ZOOM

John Joseph Moakley United States Courthouse  
1 Courthouse Way  
Boston, MA 02210

March 31, 2021  
9:00 a.m.

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1 the Bar at noon where I've had up to 1200 people on this call  
2 in the past. It's an update on COVID.

3 That's my absolute drop dead, and my only chance for  
4 lunch is to try to grab something between 11:45 and 12:00  
5 because of the rest of my schedule today, so let's see if we  
6 can't get this done in some reasonably prompt time.

7 Having said that, as I think I said last time, don't  
8 be worried talking down to me or putting this in baby talk.  
9 I will not resent it, I will appreciate it.

09:02AM 10 Mr. Hayes or your team, the floor is yours.

11 MR. HAYES: Thank you, Judge. I think that the  
12 parties, which we proposed, worked out some schedule, which I  
13 have agreed to with the other side where I'll address the  
14 proposed construction that we put forth and their first one,  
15 and then they're going to be able to address everything and  
16 then I'll reply.

17 THE COURT: That's fine.

18 MR. HAYES: Okay, thanks. We might as well start.  
19 Do you have the actual slide deck?

09:02AM 20 THE COURT: I don't have it in front of me. I  
21 received it, but I don't have it in front of me.

22 MR. HAYES: We'll put them up on the screen then.  
23 All right. Okay.

24 THE COURT: Okay.

25 MR. HAYES: Here we go. All right. In any event,

1 that one doesn't tell us much, if anything. The next slide,  
2 please, slide 2. Okay. In any event, Judge, this is the  
3 word or the phrase that we're asking for construction is the  
4 term "execution unit."

5 Now, the reason I've given you this entire three  
6 lines is to give you some idea the context in which this is  
7 used so we're not just taking words here, there, and  
8 everywhere.

9 As you can see from the claimed invention, as Bates  
09:03AM 10 claimed it, this execution unit is adapted to execute a first  
11 operation on a first input signal, so that's what we're  
12 talking about when we're talking about, "an execution unit."

13 The next slide. Now, our proposal is that the  
14 execution unit be construed to mean "a processing element  
15 that's comprising a memory circuit paired to an arithmetic  
16 circuit." And "paired" means connected, obviously.

17 Now, and Google's proposed construction basically is  
18 not -- I mean, they disagree here, there, everywhere, but  
19 there's not an affirmative proposed construction, so if we  
09:04AM 20 look at it, to go through this pretty quickly, on the next  
21 slide, we got it here, Google from the briefing has conceded  
22 that the term "execution unit" comprises a processing  
23 element, as we suggested, paired to an arithmetic operation,  
24 and that's conceded in their briefs, which we cite here for  
25 you.

1           So that leaves the only issue here on my argument is  
2 whether to include memory and circuit, as we suggest, so the  
3 issue has been paired down pretty good for us and for  
4 everybody.

5           Now, the next slide, moving on, on the issue of  
6 memory and circuit is this obviously comes from the patent,  
7 and so we have to look to the patent to see what, if  
8 anything, a processing element is because Google has already  
9 conceded that, in fact, the execution unit is a processing  
09:06AM 10 element.

11           So if we look to see, okay, if we know that, what is  
12 it, and it says here for the purposes of discussion, we call  
13 each unit, which pairs memory with the arithmetic a  
14 processing element or PE.

15           And that's why we ask the Court to, when they  
16 construe the term "execution unit" to be a processing  
17 element, as Google concedes, that is paired with arithmetic,  
18 which Google concedes, but it's also paired with memory, and,  
19 clearly, I don't think Google is going to really argue, have  
09:06AM 20 the hutzpah, so to speak, to argue that these things aren't  
21 circuits.

22           As you can look at it, that's a circuit as you can  
23 see in Fig. 4, and as you can see, the processing element,  
24 Fig. 4 is the processing element.

25           Now, that's something I think you should note

1 because later on Google is somehow trying to confuse Fig. 4  
2 and Fig. 6. Fig. 6 is the arithmetic element. The  
3 processing element that we're all talking about is Fig. 4,  
4 period, and the arithmetic unit, you can see it if you look  
5 straight at it, and you see where it says 408. That's the  
6 arithmetic unit, not the processing element, and it's clear  
7 as a bell in the patents and the briefs and the rest, and I  
8 think they agree that's the processing element for now.

9 Now, as you can see what this is doing in the  
09:07AM 10 processing element, you add an arithmetic unit right there in  
11 the middle, 408, and that's paired to a register, and a  
12 register is a memory. There's no dispute about that, so  
13 that's consistent in the intrinsic evidence, and it's  
14 consistent, obviously, with what is described and we put in  
15 the slide here in the patent, et cetera.

16 And as for the idea that's a circuit, I mean, our  
17 position is you just look at it. Anyone skilled in the art  
18 knows we're talking about a circuit here, and if you look  
19 further in the patent, it says the physical implementation of  
09:08AM 20 the PEA, that's a processing element array, e.g. chip could  
21 be replicated, e.g. tiled on a circuit board.

22 Obviously, you have circuit boards, and you have  
23 circuits on chips, and that's what we're talking about here,  
24 so that's why we suggest basically that's the way to go.

25 Now, to briefly go through, first of all, Google

1 argues, next thing, that there's no circuit because it says  
2 there's no circuit should be construed into the claim because  
3 the claim is directed to software embodiments. That  
4 affirmative argument by Google is just simply incorrect, at  
5 best.

6 The claim, as you can read, is directed to an  
7 execution unit. That's a thing. It's directed to a  
8 processing element as construed. That's a thing, it's not a  
9 software, and the processing element is described throughout  
09:09AM 10 the patent and the claim as having inputs and outputs,  
11 signals and the rest, so this thing is not directed to  
12 software on any stretch of the imagination, and what is  
13 directed to software, paragraphs -- excuse me, claims 33 and  
14 68, which I put in this slide to just show you what happens  
15 when you want to claim something directed to software, you  
16 say so, and they did, but the difference here is that they're  
17 not asserted, so I think it's fairly clear that that argument  
18 by Google is not particularly a good one.

19 Now, their next argument, moving on, is they say  
09:10AM 20 that, well, if you want the word "memory" into the claim,  
21 then there's no difference between claim 53, which is the  
22 claim at issue and claim 25, which is some dependent claim  
23 somewhere. Well, the problem with that, that is incorrect on  
24 its face.

25 Claim 25 calls for basically, as you can see, a

1 device includes memory locally accessible, so it's talking  
2 about a local accessible memory. A local accessible memory  
3 is not a memory. Obviously, memory is broader, and thus the  
4 notion that the scope of 53 and 25 are the same is just  
5 simply the argument factually is incorrect. It's also  
6 legally, as we put in the brief, irrelevant anyways, but the  
7 fact is what I want to point out is that the underlying  
8 factor is incorrect on the claim.

9 The next one, their next argument they make is they  
09:11AM 10 say not all embodiments in the patent have memory paired,  
11 have a paired memory. They affirmatively say that. That  
12 statement is false. Every embodiment in this patent has a  
13 paired memory, period.

14 Now, what do they do in the brief and everywhere,  
15 they say look at Fig. 6, and they say Fig. 6, there's no  
16 memory paired to Fig. 6. True. Well, the point is -- well,  
17 actually there is, but so what? Fig. 6 is not the execution  
18 unit, Fig. 6 is not the processing element, Fig. 6 is the  
19 arithmetic unit, and the claim is talking about an execution  
09:12AM 20 unit, and that's what we're construing, so that argument just  
21 simply isn't there, and, finally, even if it were, which it  
22 isn't, that's the log down the bottom that obviously you  
23 could have multiple embodiments, and each claim doesn't have  
24 to cover every embodiment, so I think legally but, more  
25 importantly, factually, the argument is just misstating given

1 the intrinsic evidence as we see it, and then we have that.

2 Well, that's it for the term as we see it, Judge.  
3 We've gone over our argument, which we believe is based on  
4 the intrinsic evidence as to why memory should be there, our  
5 argument why circuits should be there, and I've gone over  
6 every one of Google's arguments, which I pointed out are  
7 factually wrong, given the intrinsic evidence as set forth  
8 right on the screen, so that's our argument on the claim  
9 construction of execution unit.

09:13AM 10 Now, pursuant to this, what do you call it, an  
11 agreement, we'll go to Google's first claim of how they want  
12 to construe something in the claim, and if we look at the  
13 term that they want to construe, the language is on the top  
14 with the blue background. It says, "Low-Precision High  
15 Dynamic Range Execution Unit."

16 Now, our construction is we say that that  
17 construction, there's no needed construction for this other  
18 than the term execution unit, which I just went over, and  
19 otherwise it's plain and ordinary.

09:14AM 20 Now, what's interesting is Google's construction in  
21 the IPR. They have an IPR, and in the IPR what they  
22 represented to the patent office is that this identical  
23 phrase need no construction, plain and ordinary.

24 So they go to the Patent Office and say this  
25 construction is fine, it needs no construction, this term

1 plain and ordinary, and now they come into the District Court  
2 500 miles north and rewrite the claim, as we will see, which,  
3 obviously, they can't do, and I'll show you why.

4 The next slide is indeed the language where it says,  
5 "Low precision high-dynamic range (LPHDR) execution unit,"  
6 and I've highlighted in yellow all of the sentence so that  
7 you take it in context. We can't start taking words here and  
8 there and pick them out of context, and the execution unit,  
9 what is this low-precision high-dynamic execution unit? What  
09:15AM 10 does it do? What it does, it says it's adapted to execute a  
11 first operation on a first input signal. That's exactly how  
12 it's claimed, and that's the context of the phrase that we're  
13 going to talk about right now.

14 So what do we have here? From a legal point of  
15 view, it's obviously bedrock principle of construction, as  
16 they've got here, the construction begins with the language  
17 of the claim. And the claims, and it's also bedrock black  
18 letter law the courts do not rewrite claims. Instead, you  
19 give effect to the terms chosen by the patentee, and as clear  
09:16AM 20 as a bell, the claim as written and allowed and described in  
21 the patent shows that this execution unit is adapted to  
22 execute a first operation on a first input signal, period.

23 That's exactly how it's claimed, and they cannot  
24 just come in here and try to rewrite the claim because they  
25 don't like it and try to gin up, which is all that this is,

1 to gin up some non-infringement argument.

2 So we get the next slide, and the next slide is  
3 there to basically show you how they are indeed trying to  
4 rewrite this claim, and, most importantly, and I'll get to  
5 this in a second, but, most importantly, in their attempt to  
6 rewrite the claim on this level, what do they do? They  
7 delete the term "signal." They get rid of it. Well, you  
8 can't just delete the way it's claimed because you don't like  
9 it. That's the way it's claimed, and that's it.

09:17AM 10 You could try to prove it invalid in the sense of  
11 obviousness or whatever you want or you could try to prove  
12 you don't infringe, but you can't start changing the  
13 parameters of the claim, so if we look at that, and this next  
14 slide basically says it all. This is exactly under the law  
15 what you can't do.

16 First, they delete LPHDR, which modifies the  
17 execution unit, so they get rid of that. For what reason?  
18 There is no reason. First of all, you can't do it. They  
19 change the word cutely from "designed to" to "adapted to."  
09:18AM 20 Then they say it's designed to perform, however, the claim  
21 doesn't say it's designed to perform, it says they got  
22 adapted to execute, right, so it should say designed to  
23 perform, I mean, adapted to perform, and what do they got,  
24 "adapted to execute," so they cutely change the word  
25 "perform" to "execute," and then they say what? They add in

1 "designed to perform arithmetic operations," adding that in,  
2 "to execute a first operation," which is exactly not what the  
3 claim says.

4 And, lastly, in rewriting the claim, it says  
5 "designed to perform arithmetic operations on numerical  
6 values," right? Well, the claim is talking about signals  
7 specifically, and as you can see here, in no uncertain terms,  
8 what they have done is changed like 80 percent of the words  
9 of this phrase to take it all out of context, and then they  
09:19AM 10 will gin up some type of non-infringement, and what they're  
11 trying to do is when they say, "final result, designed to  
12 perform arithmetic operations on numerical values," et  
13 cetera, that's not what the processing element does.

14 The processing element processes a signal as  
15 specifically claimed, and, most importantly, on this issue,  
16 Judge, most importantly on this issue, and I think this is  
17 the key, this is the same claim that Google represented to  
18 the Patent Office, the PTAB, needs absolutely no  
19 construction, plain and ordinary, and now as you can see from  
09:20AM 20 this list of changes by Google, what they're trying to do is  
21 rewrite the claim. This is rewriting the claim that they  
22 presently represented needs no construction.

23 I think what they're doing, they should not be  
24 allowed as a matter of law to do any of this because it just  
25 doesn't make any sense whatsoever.

1           So, the next one is moving onto with that, we can  
2     see from the intrinsic evidence that, in fact, the claim is  
3     directed to the execution unit processing signals. The input  
4     is a signal, and that's exactly how it's described in the  
5     patent. It says on the top right, the input and intermediate  
6     values received by output, by and operated on by the PE400.  
7     The PE400 is the processing element, made, for example, take  
8     the form of electrical signals representing numerical values.

9           That's precisely how it's claimed. It's claimed in  
09:21AM 10    terms of an input being an electrical signal, an output,  
11    being an electrical signal, each representing a numerical  
12    value, but the input and output are signals, period, and so  
13    that's, obviously, I point that out because the claim is  
14    obviously consistent, exactly, almost, with the prosecution,  
15    with the specification, as you can see.

16           Now, the next one, it's not a tutorial, but to me,  
17    it's almost self-apparent, but the claimed invention is an  
18    electronic device. That's what it is. We know that, and it  
19    operates on input and output electronic signals because it's  
09:22AM 20    trying to process, for example, artificial intelligence, a  
21    signal representing an artificial intelligence issue comes  
22    in, and it comes in as an input signal, and it goes out as an  
23    electronic output signal.

24           To change that is, I think, a ludicy, but, in any  
25    event, numerical values, they don't travel on wires. They

1 don't. They just hang in the air and travel around the  
2 circuit.

3 What travels around a circuit and what an input to a  
4 circuit is is a signal. That's how it works, and we have the  
5 unrebutted testimony of our expert, and particularly pointing  
6 out the difference between signals and values, and, most  
7 importantly, indicating that they're not necessarily the  
8 same, all contrary to the arguments by Google, to begin with,  
9 and that is unrebutted because notably their expert says  
09:23AM 10 nothing about signals, values or anything.

11 They can have lawyers, have lawyer arguments to you  
12 until the cows come home, however, this is actually  
13 unrebutted evidence, and it is what it is, Judge, so, I  
14 mean...

15 And the next thing is they make an argument in their  
16 brief, and this was in the original brief, saying an input  
17 signal cannot be high-dynamic range, because the claims calls  
18 for the input signal to be a high-dynamic range, and they  
19 say, well, that can't be.

09:24AM 20 This is, again, the unrebutted testimony of our  
21 expert indicating that, indeed, signals can be high-dynamic  
22 range, exactly opposite, so we have lawyer argument saying  
23 they can't, and then we have actual unrebutted evidence  
24 saying they can, and, to boot, if you talk about that, you  
25 talk about extrinsic evidence, their expert did none of this.

1           The bottom line is now I believe this is true, and  
2       Google can respond to it, but from my reading of the briefs,  
3       they now finally concede that an input signal can be of  
4       high-dynamic range, and that's the way I read their brief to  
5       be, if I'm reading it incorrectly, I don't think I'm reading  
6       it in incorrectly, and I'm not in the business of cropping  
7       quotes or anything to that effect.

8           But irrespective of what they argue, they argue it's  
9       all attorney argument because this is unrebutted expert  
09:25AM 10      testimony about what a high dynamic range can be, can a  
11      signal be then? Answer, yes.

12           So, all that said and done, I would ask the Court to  
13      just simply find given what we presented here today that on  
14      Google's proposed construction that it be denied and that the  
15      Court just find that it's plain and ordinary, which is  
16      precisely what they represented to the Patent Office.

17           We're not asking for any more than what they told  
18      the United States Patent Office probably a few months ago, so  
19      that's our take on this, Judge, on our position with respect  
09:26AM 20      to what an execution unit is and memory, et cetera, and their  
21      first proposal.

22           THE COURT: All right.

23           MR. HAYES: I think what we agreed to now, you know,  
24      they get to do what they do.

25           THE COURT: Okay.

1 MR. HAYES: Thanks, Judge.

2 THE COURT: Thank you. Who is going to take the  
3 lead for Google?

4 MR. KAMBER: Your Honor, Matthias Kamber for Google.  
5 I'll start with a bit of a tutorial, and then Ms. Ybarra will  
6 handle the term "repeated execution" and then Mr. Bhasali  
7 will address the LPHDR execution unit term we just talked  
8 about and the first input signal representing the first  
9 numerical value phrase as well.

09:26AM 10 THE COURT: All right.

11 MR. KAMBER: Let me just queue up the slides here.  
12 Hopefully everybody can see those. Your Honor, for getting  
13 ready for today, I imagine you probably realized the claim  
14 language is rather dense to get through, and we hoped to be  
15 able to address that a little bit by providing context for  
16 two particular parts of the claim, in particular, this "low  
17 precision high-dynamic range," what do those terms really  
18 mean, what is low-precision, what is high-dynamic range?  
19 They're clearly sort of being compared to something with  
09:27AM 20 their comparative language, "low and high," and we want to  
21 provide a little bit of background on that, and then the  
22 other issue is signals representing numerical values, and  
23 specifically we'd like to talk about how computers use  
24 signals, how computers use values, and what the distinction  
25 is between signals and values as they are used in a computer

1 chip.

2 So let me take the first of those. This issue about  
3 precision and range and start maybe not at the level of baby  
4 talk but at the level of just basic numbers and how numbers  
5 are used, and probably the most basic form that you're  
6 familiar with is just an integer.

7 That's a whole number, no fractional component, that  
8 is sort of no decimal point, and these numbers, examples are  
9 zero or 26 or negative 2065, and numbers like this can be  
09:28AM 10 used to express something, but they only have so much  
11 precision if you're trying to express something that's in  
12 between 26 and 27. You can't do it with an integer, you kind  
13 of have to round to the nearest whole number.

14 For that reason, there's something known as a fixed  
15 point number, and those are used, those have some degree of  
16 precision. They are real numbers that have some fractional  
17 component where there's a fixed number of digits after the  
18 decimal point, and the example that we have here has two, has  
19 that fixed point in a place where it allows for two decimals  
09:29AM 20 in the fraction part of the number, 123.45, so 45-hundredths  
21 there is the fractional part, and this allows you to express  
22 numbers with some greater degree of precision because you're  
23 not limited to integers.

24 And, finally, there is what's known as floating  
25 point number format, and this is something you may or may not

1 remember from the 101 briefing. It's similar to scientific  
2 notation. It allows you -- it's a real number that has a  
3 fractional component and a varying number of digits after the  
4 decimal point or after the -- yes, after the decimal point,  
5 and so this allows you to express numbers with a greater  
6 degree of range because you're multiplying it by 10 to some  
7 power, 10 to the second power would be 100 here.

8 And in the examples here, we also have 10 to the  
9 5th, so 10 to the 5th would be 10,000s, and the number would  
09:31AM 10 be expressed in that way.

11 So these are the three different types of formats,  
12 integers, fixed point numbers, floating point numbers, and  
13 they kind of set up what I think is the discussion really  
14 about precision and range.

15 Now, here's an example of the distinction. Range is  
16 really I think can be simplified to the decimals to the left  
17 of the decimal point, and precision is really the fractional  
18 part to the right of the decimal point, and here we have an  
19 example of a number, 47,582,473 is the integer part of this,  
09:31AM 20 and that is the range part.

21 The range can go all the way up to, you could  
22 imagine with this type of number, 99,999,999, so you have an  
23 equal number of decimals to the right and left of the decimal  
24 place here, you have 8 to the left, you have 8 to the right,  
25 and you can express a certain range and a certain amount of

1 precision by making that choice between as to where you put  
2 the decimal point.

3 Of course, you could make a different choice, as we  
4 show here on slide 6. Here's another example. Same total  
5 number of decimals, that is 16, but 4 are, only 4 are used  
6 for precision, whereas 12 here are used for range, and, of  
7 course, that allows you to express a much larger range of  
8 numbers up to I believe 999 trillion in this particular case,  
9 but it only lets you get down to a more limited fractional  
09:32AM 10 component, so you would say that this number has higher range  
11 but lower precision as compared to the one that we saw on the  
12 prior slide.

13 Conversely, you could have the decimal point in a  
14 place where there's more precision and less range, so this  
15 would be a higher precision compared to slide 5 but lower  
16 range. The range would only go up to 99,999 in this  
17 particular case. You'd not be in the trillions, but you  
18 could express, if you needed to, a number with a greater  
19 degree of precision, that is, you could get down to the level  
09:33AM 20 of the hundred-billionths in terms of the precision in which  
21 you express it.

22 I was just showing, was using decimals, of course,  
23 and computers and decimals are really 0 to 9, right, the  
24 numbers, the decimal numbers, but in a computer, numbers are  
25 expressed typically a little differently. Things are

1 digital, as I'm sure you've heard, and that means it's 0s and  
2 1s. They are bits, and they are just 0s and 1s, and you have  
3 to represent numbers differently with bits, and here's just  
4 an example.

5 I don't think you necessarily need to know the  
6 expression for everything, but it does help set up I think  
7 the next few slides.

8 So, for example, the number 10 is expressed in  
9 binary notation by 1010. It's not 10, it's just 1010. 6,  
09:34AM 10 for example, is expressed as 110 in terms of the actual bits,  
11 and so to get to higher numbers, you need more bits, and  
12 that's how bits are used to represent numbers that we  
13 traditionally think of in the decimal format.

14 So let me talk about base-2 floating-point numbers.  
15 Because it's just two options, as we just talked about,  
16 0 and 1, you can't really represent numbers in the scientific  
17 notation that you might be more familiar with. That's  
18 Base 10, remember, scientific notation is Base 10, but,  
19 instead, in computers, people talk about or think about it as  
09:35AM 20 being in Base 2, and that has a format that looks a lot like  
21 this.

22 There is a fractional component to the number.  
23 There is an exponent component to the number, and that 1 at  
24 the very beginning is sometimes referred to as a hidden bit.  
25 It's sort of just assumed by the computer that that 1 is

1     there. You don't have to express it, and every number is  
2     essentially expressed as 1. something times 2 to the  
3     something, and I want to complain that in just a minute, but  
4     this is the format that a lot of computers, it's relatively  
5     standardized that computers use this type of format. It's a  
6     little bit confusing, but let me try to go through and  
7     explain it with one or two examples.

8             Let's take the decimal number 8, just the  
9     traditional number 8. Now, the way to express that in this  
09:36AM 10     Base 2 notation and decimal, that would be 1 times 2 to the  
11     third, 2 to the 3rd is 2 times 2 times 2, and that is 8. So,  
12     1 times 8 is a way of expressing that decimal number 8, and  
13     the way that you might express that in Base 2 format, Base 2  
14     notation, you take the binary fractional part of that, which  
15     would be 0, which corresponds to the binary numbers 0 and the  
16     exponent. There's actually something called an offset in  
17     these exponents typically. I don't think we really need to  
18     get into that, but it's just the explanation for why the  
19     binary equivalent for 3 is not like you saw a few slides ago.

09:37AM 20             Then sometimes there's what's known as a sign bit.  
21     Most number formats or most computers use a sign bit, not all  
22     do, depending on the context, but a bit might be used for the  
23     sign, but you see here again the hidden bit, you see the  
24     fractional component, and you see the exponent.

25             Here's another example with the decimal number 3.

1 Now, in this particular case in order to make the number 3 in  
2 a computer with this Base 2 format, you would say, well, 3 is  
3 1.5 times to 2 to the first. That works out to 3. So you  
4 figure out what your fractional part is in binary form. The  
5 half fractions is actually expressed by .100, so we show that  
6 here, and the exponent, again, it would just be 1, but  
7 because of the offset, it shows as something slightly  
8 different, and the sign bit here would be 0.

9 So let me pause to say that I don't think you need  
09:38AM 10 to internalize this Base 2 format, really it's just  
11 background for something else that I think is important and  
12 it's relatively easy to understand, and that is there are  
13 standardized number formats that are known and used.

14 This is an example of the IEEE single precision  
15 floating point format. This format was standardized back in  
16 1985, and it uses 32 bits to express a number in that Base 2  
17 floating point notion that we just talked about. That means  
18 that there's some number of bits that's dedicated to the  
19 exponent and some number of bits that are dedicated to  
09:39AM 20 expressing the fractional part of that particular number, and  
21 then there's a sign bit as well, as we just talked about, so  
22 in this example, and really this standard and perhaps most  
23 common format, single precision floating point format, there  
24 is -- there are eight bits of exponent and 23 bits of  
25 fraction, one sign bit for a total of 32 bits, and that's

1 just used to express the exponent is in effect the range that  
2 lets you get how far out you can get the numbers, the  
3 exponent, right, is the part like that scientific notation,  
4 and it tells you how much range you have and the fraction, of  
5 course, as we've been talking about is in effect the degree  
6 of precision you get. The more bits you dedicate to the  
7 fractional part, the more precision you can have.

8 THE COURT: And the sign is either negative or  
9 positive, is that what that means?

09:40AM 10 MR. KAMBER: That's correct, your Honor, so I  
11 believe 0 is the positive, and 1 is the negative, but I'm not  
12 entirely sure, but it's essentially just that one bit is  
13 expressing whether it's positive or negative.

14 So, in about 2008, right around when this patent was  
15 applied for, the IEEE had standardized or was standardizing  
16 what was known as the half precision floating point format.  
17 This is addressed in the patent itself. It's talking about  
18 where it talks about graphics processing units, GPUs and a  
19 16 bit format that was being developed by Industrial Light &  
09:41AM 20 Magic, this is what the patent is referring to, this half  
21 precision floating point format.

22 Now, this was lower precision, that is, the fraction  
23 is 10 bits as compared to the 23 bits that are used for the  
24 standard single precision format. It was also lower range.  
25 They used fewer bits to express the exponent, 5 bits instead

1 of 8 bits, so this is what you might term a lower precision,  
2 lower range type of number as compared to the single  
3 precision.

4 There's also, by the way, the double precision  
5 format. This is a 64-bit format that has higher range and  
6 higher precision than, or, I should say, more range and more  
7 precision really. There's 11 bits for the exponent instead  
8 of 8 and 52 bits for the fraction instead of 23, so this is  
9 what you would call I'd say a high-precision high-dynamic  
09:42AM 10 range type number.

11 And what you'll hear about perhaps later in this  
12 case is that the bfloat16 floating point format that's used  
13 by Google and others in the industry, and this has an 8-bit  
14 exponent, so the same exponent as the IEEE single precision  
15 format, but it takes away 16 of the bits from the precision  
16 or from the fraction, I should say, and has a 7-bit fraction,  
17 so a total of 16 bits, similar to the half precision format,  
18 but it trades some exponent bits for some fractions bits as  
19 part of the way that it's designed.

09:43AM 20 And that's really I think the main point to take  
21 away from this, your Honor, is that people, designers trade  
22 precision for range. This is from a textbook, Patterson and  
23 Hennessey, *Computer Organization and Design*. It's the fifth  
24 design, but this statement is in prior editions as well.

25 It's relatively well-known that there is some

1       compromise being made between the size of the fractions and  
2       the size of the exponent, and, by the way, that blue text on  
3       the slide is actually original. That is in the textbook.  
4       It's called out.

5               And as this textbook points out, the trade-off is  
6       one between precision and range, increasing the size of the  
7       fraction enhances the precision of the fraction, while  
8       increasing the size of the exponent increases the range of  
9       numbers that can be represented, so it's really just a  
09:44AM 10       choice. It's a tradeoff that designers are making sometimes  
11       in systems between precision and range, how many bits they  
12       are using to express the exponent vs. the fraction in terms  
13       of the numbers that they are using.

14               Your Honor, unless you have questions about that, I  
15       was going to move onto the signals and values and how those  
16       are used in computers.

17               THE COURT: Go ahead.

18               MR. KAMBER: So in the customary sort of  
19       silicon-based world of computer processors, there are in  
09:45AM 20       effect two different types of signals, analog signals and  
21       digital signals. Of course, everything at some point really  
22       has to go on a wire in the context of these computer chips,  
23       but there are known analog computer types, there are known  
24       digital computer types, and there are hybrid analog digital  
25       systems as well, and I want to just show or illustrate here

1 an analog signal waveform.

2 You see this here. It has different amplitudes, you  
3 could think of this as perhaps different voltages that are  
4 coming in to being read, and they're being sampled on some  
5 particular time interval, whatever it might be. The time  
6 intervals are sometimes small, and the amplitude of the  
7 voltage can really represent anything.

8 If you -- let's say this voltage here on the left,  
9 on the Y axis, 8 volts could represent the number 100, they  
09:46AM 10 could represent the number 1,000, they could represent the  
11 number 1 million, however, the designer of the system might  
12 want it to work.

13 There is some conversion in effect between the  
14 physical, the voltage, and what it represents in terms of a  
15 particular value in the system, but let's just take the basic  
16 example where it would be 1 to 1, and you would try to be  
17 representing just the decimals here, and as the waveform  
18 comes in, it is read, and it matches up to the waveform  
19 05185605, so that comes as being read. Those voltages are  
09:47AM 20 being read off, and those can represent whatever it might be.

21 In contrast, digital waveforms really have only two  
22 states, sort of what we talked about before, this binary  
23 number system. You really are only using a 0 or a 1, on or  
24 off, and so this is what people sometimes call a perfect  
25 waveform. Of course, it takes some amount of time to go from

1 0 to the 1, so there's a little bit of a slant there, but  
2 this is a perfect square wave in this representation, and  
3 most of the time, the 0 isn't an exact 0 either, but you're  
4 essentially trying to show a high and a low state in a  
5 digital signal to represent that 0 and the 1.

6 Now, digital signal waveforms because of the way  
7 that they are formed -- by the way, this gets, as they comes  
8 in, of course, it's being read as the series of either  
9 01001101. As it comes in, it's being read as the one state  
09:48AM 10 or the other state, the on or the off.

11 And for that reason, your Honor, those types of  
12 signals, digital signals, are a lot less susceptible to  
13 disruption, to noise. Imagine a cell phone being nearby  
14 causing interference or heat or any number of things. It  
15 might throw off the signal slightly, as is illustrated here  
16 in slide 21, but it's not going to throw it off in a way that  
17 should generally affect the performance of the computer and  
18 how that's read.

19 Something close to a 0 will still be interpreted as  
09:49AM 20 a 0, something close to 1 will be interpreted as a 1, and so  
21 the noise here, unless it's really extreme, will not impact  
22 how those numbers are interpreted by the computer, those  
23 digital signals are then interpreted by a computer.

24 It's not true, however, for analog signals. Analog  
25 signals are, again, it's the example of the noise from

1 perhaps a cell phone. They are susceptible to this type of  
2 noise. Their waves are more affected, and because you're  
3 actually reading the amplitudes, the voltage directly,  
4 there's a direct correspondence to the value that it's meant  
5 to represent. It is more susceptible to noise.

6 Heat is a form of noise. Of course, processors  
7 generate heat. They have to be cooled in some shape or form  
8 most of the time in order to operate properly, so here you  
9 see an example where the heat changes this waveform  
09:50AM 10 significantly, and because of it, readings like what should  
11 read as 5 or 8 are impacted in such a way that they are,  
12 pardon me, below 5 or below 8 or at different levels than one  
13 might expect, and so analog systems are just known to -- and  
14 the experts agreed on this, by the way, in this case -- that  
15 analog signals are susceptible to noise. Repeated results  
16 for that reason are difficult to have because of that noise  
17 feature.

18 And with that, your Honor, unless you have  
19 questions, I'd like to turn it over to Ms. Ybarra to talk  
09:50AM 20 about the indefiniteness issue with respect to repeated  
21 execution.

22 THE COURT: All right.

23 MS. YBARRA: Good morning, your Honor,  
24 Michelle Ybarra from Keker, Van Nest & Peters for Google.  
25 We'd like to start our argument with the term, "repeated

1 execution" because it's case dispositive, so should the Court  
2 find the term to be indefinite, as we think it should, all of  
3 the asserted claims are invalid, and here's why we believe  
4 you should find repeated execution is indefinite.

5 Matthias, could we go to the next slide, please.  
6 Repeated execution appears in all of the asserted claims and  
7 appears specifically in the claim language that provides the  
8 test for determining whether a device infringes.

9 If we could go to the next slide. We're looking  
09:51AM 10 here specifically at claim 1 of the '273 patent, and this is  
11 the test. It's kind of dense, but I'm going to drill down on  
12 this briefly.

13 The claims cover an LPHDR unit that after repeated  
14 execution of an operation produces results that differ on  
15 average by a certain degree from the results of an exact  
16 mathematical calculation of that same operation.

17 If we could go to the next slide. This is kind of  
18 isolating the language that's doing the work here, and I  
19 think it's helpful to hone in on this. This says, "A device  
09:52AM 20 falls within the scope of the claim if the statistical mean  
21 of the output values over a repeated execution of an  
22 operation differ by at least .05 percent from the exact  
23 calculation."

24 So the claimed invention doesn't evaluate results on  
25 an execution by execution basis, but it's looking at the

1 average of results after repeated execution of an operation  
2 and compares that average to the results of an exact  
3 mathematical calculation. In that way, infringement is  
4 defined primarily not by how the device operates but by the  
5 results it produces, and this test has particular  
6 consequences for analog systems, which are susceptible to  
7 noise that can cause the system to generate different results  
8 for the same inputs, as Mr. Kamber was just explaining.

9 In an analog embodiment, noise will cause the  
09:53AM 10 results to vary, therefore, the number of times an operation  
11 is repeated will shift the average of the statistical mean  
12 with each execution of the operation.

13 If we could go to the next slide. And that therein  
14 lies the problem. The claim language that supplies the test  
15 doesn't answer the fundamental question how many times must  
16 one repeat the operation in order to average the output and  
17 compare the results to an exact mathematical calculation, so  
18 the claim language creates a zone of uncertainty about the  
19 scope of the invention and the circumstances under which a  
09:54AM 20 device infringes.

21 Nautilus makes clear that the claims when read in  
22 the light of the specification and the prosecution history  
23 have to provide reasonable certainty for those skilled in the  
24 art about the scope of the invention, so it's not sufficient  
25 that the claims capable of interpretation, as we believe

1 Singular suggests.

2           There's no doubt that repeated execution here means  
3 more than one, but that tells you nothing about how many  
4 executions are necessary such that you can calculate the  
5 statistical average of the output values and compare that  
6 average to the result of an exact mathematical calculation to  
7 figure out whether those figures differ by the minimum amount  
8 claimed in the patents, and it's the basis of that comparison  
9 that tells you whether a device infringes, but there's  
09:55AM 10 nothing in the claims, the specification or the prosecution  
11 history that provides any kind of objective anchor that makes  
12 the term definite.

13           If we could go to the next slide. As I mentioned  
14 before, this is particularly consequential in the context of  
15 an analog embodiment where the same testing can lead to  
16 different results.

17           Google's expert, Dr. Wei, demonstrated when noise is  
18 a factor, as it is in analog embodiments, performing the same  
19 operation with the same inputs will yield different results,  
09:55AM 20 the average of which may fall above or below the claimed  
21 error threshold described in the patents.

22           And Singular's expert, Dr. Khatri, agrees. He says  
23 in paragraph 33 of his declaration devices that using analog  
24 signals to represent numbers introduce noise in their  
25 computations and performing the same operation twice with

1 identical inputs will statistically produce different output  
2 values and initially a fluctuating arithmetic average.

3 In his own experiment reflected in the graph at  
4 paragraph 34 of his declaration, he describes the arithmetic  
5 average as unstable and one that fluctuates significantly  
6 over short periods of time, so what that means is that the  
7 average will potentially drift above and below the claimed  
8 error threshold and will sometimes satisfy the claim  
9 language, the test in the claimed language and sometimes  
09:57AM 10 won't.

11 THE COURT: Let me just make sure I understand. So  
12 we're talking only -- let me put aside the analog hybrid,  
13 whatever that is, so we're talking about analog signals and  
14 we're talking about a short period of time, correct?

15 MS. YBARRA: Yes.

16 THE COURT: In other words, over time, this, I don't  
17 know what the right word is, but flattens out or this noise  
18 business becomes less important, in other words, if you  
19 perform this 10 million times, it's different from 10 times?

09:57AM 20 MS. YBARRA: That's what Dr. Khatri contends, and  
21 that's what his graph shows.

22 THE COURT: Okay.

23 MS. YBARRA: Exactly what is a short period of time,  
24 he does not define or specify.

25 THE COURT: Okay.

1 MS. YBARRA: If we could go to slide 29. I'm sorry,  
2 we are on slide 29. Slide 30 then. So, as I was saying, how  
3 many times one performs repeated executions of this same  
4 operation is critical to whether or not the test is  
5 satisfied, but there's nothing in the spec. or the  
6 prosecution history that provides guidance on how many  
7 repeated executions are necessary.

8 That's not just Google's position but Singular  
9 itself fails to cite any intrinsic evidence on this point.  
09:58AM 10 Instead, Singular relies entirely on the opinion of his  
11 expert, Dr. Khatri, who offers nothing more than an opinion  
12 based on his subjective experience.

13 And here's how Singular frames it on slide 30:  
14 Singular says you can't look at repeated execution in  
15 isolation because the whole point of performing repeated  
16 executions of an operation is to obtain the statistical mean  
17 of the output values.

18 And, again, relying entirely on Dr. Khatri's opinion  
19 without citing any support in the spec., Dr. Khatri opines  
09:59AM 20 that a person of skill in the art would rely on the law of  
21 large numbers to understand the scope of the claim, and law  
22 of large numbers states that the average of the results  
23 obtained from a large number of trials should be close to the  
24 true or expected value and will tend to get closer to that  
25 value the more trials you perform, so this is the line

1 flattening out that you just referenced, your Honor.

2 Dr. Khatri argues that a person of skill in the art  
3 would know the law of large numbers, and, therefore, would  
4 understand that executing an operation enough times will  
5 yield a stapled population mean, where the average won't  
6 meaningfully fluctuate, and you can determine whether  
7 invention satisfies the claims. What if no staple mean ever  
8 emerges? Dr. Khatri argues then the repeated execution  
9 limitation is never met.

10:00AM 10 And if we could break this down because none of this  
11 is derived from the specification of the prosecution history.  
12 These are entirely Dr. Khatri's opinions, and he concedes  
13 that how many repeated operations or repeated executions of  
14 the operation are necessary to satisfy the claim language is  
15 a completely subjective standard.

16 So going to slide 31, first, as to the law of large  
17 numbers, which Dr. Khatri contends a person of skill in the  
18 art would apply when interpreting the claim language, he  
19 can't point to anything in the claims or the specification or  
10:00AM 20 the prosecution history that references the law of large  
21 numbers, and he, in fact, rejects the notion that the skilled  
22 artisan would know the patent incorporates the law of large  
23 numbers, saying I don't know where you got that idea from, I  
24 never said that.

25 If you look at his declaration, paragraphs 27 to 36

1 of his declaration, Dr. Khatri fails to cite any intrinsic  
2 evidence on the number of required executions, so he can't  
3 identify any guidance as to the number of repeated operations  
4 necessary to satisfy the claim language.

5 If we could go to the next slide, please. Instead,  
6 Dr. Khatri says you perform enough repeated executions until  
7 the statistical mean is stable, and how many executions are  
8 required to reach a stable statistical mean? Well, remember,  
9 Dr. Khatri admits that in an analog system, performing the  
10:01AM 10 same operation will produce different output values, and  
11 initially a fluctuating average due to noise.

12 And I want to make clear in reference to the  
13 question you asked earlier, your Honor, it's not the noise,  
14 noise doesn't change or go away over time, it's just that it  
15 averages out, the line flattens out, so Dr. Khatri says  
16 initially you get a fluctuating average. He doesn't identify  
17 the point where the average stops fluctuating, but he says at  
18 some point, the average will stabilize, and it's at that  
19 point you've performed enough repeated executions that you  
10:02AM 20 could compare the new stable average to the results of an  
21 exact mathematical calculation and determine whether a device  
22 infringes the asserted claims, and the problem with  
23 Dr. Khatri's interpretation, and he concedes this, is that  
24 what he deems as stable a statistical average or what he  
25 deems is a stable statistical mean is entirely subjective.

1           He describes a stable statistical mean as an average  
2     that never materially changes again and does not meaningfully  
3     fluctuate or has ceased to fluctuate significantly. All of  
4     those determinations, whether the average doesn't materially  
5     change again or meaningfully fluctuate or ceases to fluctuate  
6     significantly are subjective determinations that according to  
7     Dr. Khatri are context dependent.

8           If we could go to the next slide, please. At his  
9     deposition, Dr. Khatri was asked multiple times how a person  
10:03AM 10    of skill in the art would know when an average is stabilized,  
11     and his answer was always some version of what you see on  
12     slide 33.

13           For example, he says a person of skill in the art  
14     familiar with a particular circuit, application and  
15     technology would know when an average doesn't meaningfully  
16     fluctuate, and they would know for certain application what  
17     meaningful is in terms of meaningfully fluctuating, and a  
18     person of skill in the art would know for their circuit when  
19     that happens, when that was reached.

10:04AM 20           This is precisely what the Federal Circuit says you  
21     can't do. In the *Datamize* case that we cite in our  
22     supplemental claim construction brief and the opening brief,  
23     the Federal Circuit says, "The scope of the claim language  
24     cannot depend solely on the unrestrained subjective opinion  
25     of a particular individual purportedly practicing the

1 invention."

2           Nowhere does Dr. Khatri offer any objective indicia  
3 by which a person of skill in the art would make this  
4 determination that's sufficient repeated executions have been  
5 performed to calculate those statistical mean. It's always  
6 context dependent, according to him.

7           If we could go to the next slide, please.

8 Dr. Khatri even gave this example about a circuit that is  
9 designed to operate on Mars. For that circuit, he said,

10:05AM 10 "What is a meaningful variation in the average of the outputs  
11 that would differ from a circuit operating on Mars, between a  
12 circuit operating on Mars and a circuit operating on earth?"  
13 In the Mars circuit, the meaningful variations would be much  
14 smaller as compared to the earth circuit, where the  
15 meaningful variations might be just larger.

16           So, his position on how many repeated executions are  
17 necessary to achieve a stable statistical mean is basically,  
18 it depends. It's exactly -- this is exactly counter to what  
19 we are taught in *Nautilus*, the Supreme Courts says in  
10:05AM 20 *Nautilus*, and his answer doesn't provide any objective  
21 guidance to a person of skill in the art about the scope of  
22 the invention, as the patent statute requires.

23           There's an additional problem with Dr. Khatri's  
24 position. This is we're talking about an apparatus claim  
25 here, which either infringes or doesn't but is not

1 contextually dependent, so because Dr. Khatri's opinion is  
2 based solely on his experience and is not tethered to any  
3 supporting evidence in the intrinsic evidentiary record, it  
4 does nothing to answer the question that we're still left  
5 with, which is how many repeated executions of an operation  
6 are necessary and the context of the asserted claims.

7 So the metes and the bounds of the claims are not  
8 clear, and the claim is indefinite. If we can go to the next  
9 slide, please.

10:06AM 10 Singular alternatively argues that this is not a  
11 dispute that the Court can resolve now because there are  
12 disputes of fact that preclude deciding this issue at claim  
13 construction, and it should go to the jury, but there are no  
14 disputes of fact here, and we elaborate on this on  
15 pages 1 to 3 of our supplemental claim construction brief,  
16 and we distill those points here on slide 35.

17 There's no dispute that repeated executions applies  
18 the test, no dispute that the spec. and the prosecution  
19 history fail to provide guidance about how many executions  
10:07AM 20 are required, and neither Singular nor Dr. Khatri can point  
21 to any intrinsic evidence on the number of repeated  
22 executions required or discussing the law of large numbers or  
23 in support of Dr. Khatri's theory that enough repeated  
24 executions will produce a stable statistical mean that a  
25 person of skill in the art will know when they see.

1           There's also no dispute the asserted patents cover  
2 analog systems that will produce inconsistent results each  
3 time you execute an operation, meaning the average of those  
4 outputs will shift depending on the number of executions  
5 performed, leaving you with a mean that can drift above or  
6 below the claimed error threshold.

7           The only disputes between the parties are over the  
8 legal conclusions drawn from these facts, but it's not about  
9 the facts themselves, and the dispute over the legal  
10:08AM 10 conclusion drawing these facts is a question for the Court  
11 that the Court can and should decide now because Google has  
12 met its burden with clear and convincing evidence to show  
13 repeated execution is indefinite. We believe the Court  
14 should so find. I'll stop there. If you have any questions,  
15 your Honor.

16           THE COURT: No. Okay.

17           MR. BHANSALI: Good morning, your Honor.

18 Asim Bhansali of Kwun, Bhansali, Lazarus, and for Google, I'm  
19 going to address the two remaining terms, and I'll start with  
10:09AM 20 "low precision high-dynamic range execution unit" term, and  
21 if we could go to the next slide.

22           So before talking about the intrinsic evidence, your  
23 Honor, I just want to address this point that Mr. Hayes  
24 mentioned a few times about Google's position on this term in  
25 the Patent Office in the IPR that we're waiting for the

1 institution decision that we're going to get in the next  
2 month and a half or so.

3 There's nothing, he hasn't pointed to any  
4 inconsistency between the position we've taken there and what  
5 we're saying here. It's not at all unusual for a petitioner  
6 not to seek a construction in the PTAB where the petitioner  
7 doesn't believe that that construction is necessary to map  
8 the prior art onto the claims.

9 So it's not really that we're taking at all an  
10:10AM 10 inconsistent position, they haven't pointed to any  
11 inconsistency, it's just the construction in our view wasn't  
12 necessary at the petition stage to show that the prior art  
13 maps to the claims.

14 And the other thing I would say, your Honor, is we  
15 also heard a lot from Mr. Hayes about how Google is  
16 purportedly rewriting the claim language, but here we put, to  
17 start on this term, our proposed construction on the right  
18 and Singular's on the left.

19 And as you can see, and as we'll see in a moment  
10:10AM 20 when we look at the claim language, our proposed construction  
21 is actually much more faithful to the claim language than  
22 Singular's is. Low-precision high-dynamic range comes right  
23 out of the claim language.

24 The processing element, we both agree, this is a  
25 processing element. The performance of arithmetic operations

1 is something we also both agree that the unit does and is  
2 also in the claim language and the use of numeric values,  
3 being what the arithmetic operations are performed on, as  
4 we'll see is very much supported by the spec. and is also  
5 referenced in the claim language.

6 By contrast, it's Singular that is seeking to read a  
7 hardware limitation into these claims, and so with that, let  
8 me just briefly indicate what the three, what I think the  
9 three areas of dispute are here, and then I'll kind of  
10 address those in turn.

10:11AM

11 The first is, as I said, whether or not the claim  
12 should be construed to, as the claim language requires,  
13 include this low-precision and high-dynamic range as part of  
14 the execution unit.

15 The second dispute is whether or not, as Singular  
16 proposes, this hardware limitation, the arithmetic circuit  
17 and the memory circuit should be read into the claim.

18 And the third dispute is whether or not this claim,  
19 this term should be construed such that arithmetic operations  
20 are performed on numeric values as opposed to on the physical  
21 signal.

10:12AM

22 That last point actually comes up also in the  
23 context of the next term, and so just for kind of efficiency,  
24 I'll address that in the context of the next term because  
25 both, in both terms, the question is whether the arithmetic

1 operation is performed on numeric values.

2 So let me start with the first issue, and if we  
3 could go to the next slide. The question is whether the  
4 execution unit should be construed, whether the term to be  
5 construed should be the "low-precision high-dynamic range  
6 execution unit," and we would posit, your Honor, that our  
7 position comes straight out of the claim.

8 If we look at the first line of the claim, what's  
9 being claimed is a "low-precision high-dynamic range  
10:13AM 10 execution unit." Singular would propose to read that out of  
11 the claim and simply have an "execution unit" rather than  
12 an LP --

13 THE COURT: I'm not sure, to me, those are  
14 adjectives that modify execution unit, so if you put it back  
15 in, if you define execution unit to be low-precision  
16 high-dynamic range execution unit, isn't it then redundant,  
17 wouldn't that claim read, "At least one first low-precision  
18 high-dynamic range, low-precision high dynamic range  
19 execution unit"?

10:14AM 20 MR. BHANSALI: If you were to do it that way, your  
21 Honor, but we're not -- we're not proposing, to be clear,  
22 we're not proposing that because I guess there's a difference  
23 between the term we're proposing to be construed and what  
24 Singular is proposing to be construed.

25 The term we're proposing is "LPHDR execution unit,"

1 right, so that redundancy that your Honor is positing  
2 wouldn't be there, and I think this is actually an important  
3 point because the reason why we're proposing to construe  
4 LPHDR execution unit is twofold.

5 First, if we go to the last element that we see on  
6 this slide, it says, "Wherein the number of LPHDR execution  
7 units in the device exceeds by at least 100," and then it has  
8 further language of describing that, so the fact-finder is  
9 going have to -- is going to have to find that there are 100  
10:15AM 10 of these LPHDR units, so in the first element, they have to  
11 map that and say, okay, what's the LPHDR execution unit, and  
12 then at the end, they have to say, okay, there are 100 of  
13 these, and so that's why it's important that the whole phrase  
14 be defined so that when applying the claim, one can be sure  
15 that what we're mapping the first part of the claim on is  
16 also where we're finding 100 of these LPHDR execution units.

17 The only thing, the other point, your Honor, is that  
18 Singular's response is, well, we don't need to construe this  
19 to include low-precision high-dynamic range because the  
10:16AM 20 second clause, that wherein the dynamic range clause defines  
21 the low-precision and the high-dynamic range, and we don't  
22 necessarily disagree that this defines the dynamic range and  
23 an error level, but the point is the claim is on not just an  
24 execution unit that executes this way, it's on a  
25 low-precision high-dynamic range execution unit, and if we

1 look at the other claims in the patent, the other claims in  
2 the patent actually have different -- there are other claims  
3 in the patent that have different dynamic ranges and  
4 different error levels.

5 In fact, other dependent claims that depend from the  
6 same independent claim in the '273 patent that claim 53  
7 depends from, such as claims 47, 48 and 49, have a different  
8 dynamic range and a different error level, but, importantly,  
9 they all claim the same low-precision high-dynamic range  
10:17AM 10 execution unit, so that low-precision high-dynamic range  
11 execution unit broadly covers all of those dynamic ranges and  
12 error levels, and that's why, that's the second reason why  
13 it's important that we're construing this entire concept of  
14 the LPHDR execution unit rather than just execution unit,  
15 which is actually, you know, a term that is just, you know,  
16 just like a processing element.

17 THE COURT: So 53 is a dependent claim?

18 MR. BHANSALI: Yes, your Honor.

19 THE COURT: It depends from what claim?

10:17AM 20 MR. BHANSALI: It depends from claim 36. It  
21 actually has like a sub-dependency, so let me just make sure  
22 I state this exactly correctly, your Honor. I have the  
23 patent up here. If I could just have one second to scroll to  
24 it.

25 So, 53 depends from 43, your Honor, and 43 then

1 depends from 36, and so 36 has kind of like most of the  
2 language except that it has a different dynamic range and  
3 doesn't include that part at the end about the 100 units.

4 THE COURT: Okay.

5 MR. BHANSALI: Then 43 adds the 100 units, and then  
6 53 changes the dynamic from 1 over 65,000 to 65,000 to what  
7 you see here, which is 1 over 1,000,000 to 1,000,000.

8 THE COURT: Okay. Can I ask what I'm sure is a  
9 stupid and irrelevant question, but I'm going to ask it  
10:19AM 10 anyway. It says, "Exceeds by at least 100 to non-negative  
11 integer number of execution units." How could that number be  
12 below zero? In other words, why does it have to say  
13 nonnegative? I'm not sure I follow that. If you don't know  
14 why --

15 MR. BHANSALI: Of course, Dr. Bates wrote the claim,  
16 so I can't speak to that.

17 THE COURT: I mean, we're talking about a physical  
18 thing, right? Are we not? "Non-negative integer number of  
19 execution units."

10:19AM 20 MR. BHANSALI: Well, your Honor, that gets to the  
21 next point. The execution unit can be implemented in  
22 software, but it is, I mean, even software has an embodiment,  
23 right, it does exist, and so the way we read this claim is  
24 that what this is sort of claiming is this idea of the  
25 parallel processing and that there are 100 of the LPHDR

1 execution units.

2 The non-integer part, as I think your Honor sees,  
3 that's the number of units that are adapted to execute -- is  
4 the operation that are at least 32 bits wide.

5 THE COURT: Okay. It's an idle and curious point.  
6 I didn't mean to interrupt you. Go ahead.

7 MR. BHANSALI: I completely understand, your Honor.  
8 That's actually a good segue though, as I said, to the next  
9 point, which is whether we should be reading this hardware  
10:20AM 10 limitation of the circuit into the claim, and so there, as  
11 your Honor heard, they want to read both an arithmetic  
12 circuit and a memory circuit into the claim, so let me start  
13 with that in general, just the idea of reading the hardware  
14 in the claim.

15 There's nothing in the claim language here that  
16 supports reading a hardware requirement into the execution  
17 unit. On that basis alone, the attempt to narrow the claim  
18 to a hardware embodiment should be rejected.

19 Now, Mr. Hayes said, well, it's a thing, an  
10:21AM 20 execution unit is a thing and suggesting that that is a  
21 limitation to a hardware embodiment, but as the specification  
22 states and as Singular concedes in the briefing, the  
23 specification discloses a software embodiment, which means  
24 the claims should be construed to cover that software  
25 embodiment, and Singular has offered no basis for why any

1 particular claim should be construed in a way that reads out  
2 that software embodiment.

3 Moreover, the claim that Singular --

4 THE COURT: Does the software embodiment have an  
5 execution unit?

6 MR. BHANSALI: Yes, your Honor.

7 THE COURT: Okay.

8 MR. BHANSALI: Yes, your Honor. Well, of the LPHDR  
9 execution unit. It is an execution unit, but, again, it's  
10:22AM 10 the execution unit that's claimed in the patent, not just a  
11 generic execution unit.

12 And if we could go to the next slide, please. So,  
13 Singular, and we saw this same claim actually reproduced in  
14 Mr. Hayes' slide, Singular says, oh, no, wait a minute, we  
15 have other claims, unasserted claims, that claim the software  
16 embodiment so it's okay to read the software embodiment out  
17 of the asserted claims.

18 Well, the problem with that is actually these other  
19 claims support our view that you can't read the software  
10:22AM 20 embodiment out of the term we're seeking to construe, which  
21 is the LPHDR execution unit, so claim 68 is the claim that  
22 they cite for having the software embodiment, and, in fact,  
23 if you look at the preamble, it refers to a computer readable  
24 memory storing computer program instructions, also could be  
25 described as software, and then where it says it's emulating

1       this device.

2               Now, what's important here is that this claim, which  
3       is the one they identify as the so-called software claim,  
4       claims the exact same low-precision high-dynamic range  
5       execution unit as in the asserted claim.

6               If we could quickly go back to the last slide. So  
7       here we see highlighted in the first, "Comprising at least  
8       one first low-precision high-dynamic range execution unit,"  
9       okay. If we go to the next slide, back. Again, "One first  
10:23AM 10      low-precision high-dynamic range execution unit," so the  
11      point is whether it's the claim that Singular itself is  
12      saying is the software claim or the asserted claim, the LPHDR  
13      execution unit, we'll take Singular's term, the "execution  
14      unit" is exactly the same, so you can't construe it in one  
15      claim to have a hardware limitation and then say at another  
16      claim, it's only embodied in software.

17              The claim has to be construed consistently across  
18      the patent, and, in fact, the family of patents, and so this  
19      claim, the very fact that it has a software embodiment of the  
10:24AM 20      same LPHDR execution unit that's in the asserted claim  
21      supports and, in fact, requires that the LPHDR execution unit  
22      in the asserted claim be broad enough to cover software.

23              So, for that reason, the hardware limitation  
24      shouldn't be included at all.

25              THE COURT: Let me make sure I understand. But

1 they're saying they're emulating a second device comprising  
2 this execution unit, so isn't that different from saying  
3 there is going to be a second device, right? I want to make  
4 sure I understand this argument because --

5 MR. BHANSALI: Yes, your Honor.

6 THE COURT: -- what I think I heard you say is you  
7 can't construe 53 to have a hardware limitation because then  
8 68 doesn't make sense.

9 MR. BHANSALI: Yes, your Honor.

10:25AM 10 THE COURT: But isn't 68 saying it's a software that  
11 emulates a hardware device, I'm being very simplistic here,  
12 but isn't that what 68 says?

13 MR. BHANSALI: Yes, your Honor, and so that's the  
14 software embodiment. In other words, it doesn't -- to be  
15 clear, it doesn't say software that emulates a hardware  
16 device, it says software that emulates the low-precision  
17 high-dynamic range execution unit, and so in this claim,  
18 emulation is the way that the software embodiment of the  
19 low-precision high-dynamic range execution unit is  
10:26AM 20 implemented, and so in order for that embodiment to work, the  
21 LPHDR execution unit has to be broad enough to cover  
22 software.

23 So, I mean, I think the emulator is just -- that's  
24 just a way that the software is -- because it's not like a  
25 software application, right, it's software that's performing

1       this execution.

2               THE COURT: And, again, we're probably spending too  
3 much time on this point, but let's say that claim 53 covers  
4 an abacus and it's a physical thing, and then claim 68 says  
5 software that emulates an abacus. That doesn't necessarily  
6 mean an abacus isn't a physical thing, it means you are  
7 claiming an abacus and you are claiming software that  
8 emulates an abacus, right? I don't see how those are  
9 inconsistent.

10:27AM 10               MR. BHANSALI: Yes, your Honor. If it had claimed  
11 an abacus, I think that would be the case, but I think the  
12 difference here is they are just claiming the idea of a  
13 low-precision high-dynamic range execution unit, and an  
14 execution unit is not inherently hardware, it's just, I mean,  
15 software is often referred to as having units, right, so, in  
16 other words, this isn't a scenario where their term is itself  
17 on its face limited to a physical device. It's actually  
18 something that could be implemented in software, and they  
19 have claims that are doing so, and the specification also  
10:28AM 20 refers to having the execution unit embodied in software.

21               THE COURT: Okay.

22               MR. BHANSALI: Your Honor, if I could just read from  
23 the spec., just, for example, the language here, they have,  
24 "Moreover, generally, any of the techniques described above  
25 may be implemented, for example, in hardware, software

1 tangibly stored on a computer readable medium, firmware or  
2 any combination thereof."

3 So, they're making clear in the specification that  
4 these techniques, the LPHDR execution can be implemented in  
5 hardware or software. Just to kind of reaffirm the point of  
6 why this is different from kind of an abacus, because they  
7 are referring to an execution unit that could be a software  
8 unit.

9 THE COURT: Okay.

10:29AM 10 (A recess was taken.)

11 THE COURT: Are we ready to resume?

12 MR. BHANSALI: Your Honor, I'm ready.

13 THE COURT: Mr. Bhansali, go ahead.

14 MR. BHANSALI: So where we left off was we talked  
15 about just the problem generally with limiting the term  
16 "LPHDR execution unit" to a "hardware embodiment," but  
17 there's a further problem with Singular's attempt to read in  
18 this idea of a paired memory into that term, and to be clear,  
19 what Singular is asking the Court to do is to read the term  
10:39AM 20 "execution unit" as a person of ordinary skill in the art  
21 would understand it to require a paired memory circuit.

22 They are not saying that this is a means plus  
23 function claim where we're limited to a particular structure  
24 disclosed in the patent. That's not what they're arguing,  
25 what they're arguing is "execution unit," just as that term

1 generally would be construed has to include a paired memory  
2 circuit.

3 Well, not only is that not supported by the  
4 extrinsic evidence of how a person of ordinary skill in the  
5 art would understand processing element, as I'll show in a  
6 moment, it's also not supported by the specification.

7 Here, we have language from the specification that  
8 talks about the embodiment where the embodiments, plural,  
9 where they are including memory as part of their model, and  
10:40AM 10 we see here, for example, they say our model of machine, and  
11 then they reference it providing a small amount of memory  
12 local to each arithmetic unit, and then further down below,  
13 if we could stay on that slide for a minute, the prior slide.

14 Then further down at the bottom, they talk about,  
15 they say of which signal is only an instance, and then for  
16 purposes of discussion below, we call each unit which pairs  
17 memory with arithmetic a processing element, but,  
18 importantly, in this entire discussion, they have the  
19 language, which is sort of consistent with what a person of  
10:41AM 20 ordinary skill in the art would understand an execution unit  
21 to be that these are not limitations of the present  
22 invention.

23 In other words, the description in the  
24 specification, the one place that they are pointing to where  
25 it says that memory is paired with arithmetic, that's part of

1 a description of an embodiment that the inventor himself,  
2 Dr. Bates, said that's not a limitation of the invention, so  
3 at the time they wrote the patent, they said this is not a  
4 limitation of the invention, but now they're coming into  
5 court and saying, oh, well, wait a minute, the LPHDR  
6 execution unit has to be paired with a memory.

7 But that's not simply not the case, not only because  
8 they say that here in the spec., but if we could go to slide  
9 43, so slide 43 is -- your Honor mentioned reading a computer  
10 science treatise at the break.

11 This is actually a computer science book that we  
12 cited in our papers from the time, actually, prior to the  
13 time of the patent, referring to DSP integrated circuits, and  
14 it defines this notion of a processing element, and it kind  
15 of describes the different elements, and it says this is what  
16 a processing element is, and then it says, "We use the more  
17 general term "processor" with its internal memory and control  
18 circuitry," so the point is here that extrinsic evidence also  
19 confirms what we see in the extrinsic evidence.

10:43AM 20 You, obviously, look to the intrinsic evidence  
21 first, as the Court knows, and then the extrinsic evidence,  
22 and the extrinsic evidence says, "which is that a processing  
23 element does not have to include memory," and so if we can  
24 now go back to slide 41, so this is a description on the  
25 left, we see the asserted claims, and on the right, we see

1 certain dependent claims that actually are dependent from the  
2 independent claims that are asserted, and so the asserted  
3 claims do not have a memory requirement. That's not  
4 described in those claims. By contrast --

5 THE COURT: What does the locally accessible part of  
6 it mean? I mean, that suggests to me that there's some other  
7 kind of memory that's not locally accessible, in other words,  
8 that there's a broad of category of memory, a subset of which  
9 is memory that's locally accessible. Is that wrong?

10:44AM 10 MR. BHANSALI: Your Honor, the locally accessible  
11 certainly is a description of memory, but the asserted claims  
12 don't refer to memory at all, so, in other words, it's not as  
13 if the asserted claims say wherein the device includes  
14 memory, and then the dependent claims come in and say wherein  
15 that memory is locally accessible.

16 The asserted claims don't refer to memory at all,  
17 and this is actually one of the problems with the  
18 interpretation that Singular is offering. Well, they say,  
19 Well, paired with memory, but they don't actually offer any  
10:45AM 20 extrinsic evidence or any language from the spec. that says,  
21 well, paired memory is different from locally accessible  
22 memory.

23 For example, paired memory Mr. Hayes said today,  
24 well, that just means connected to, but there's actually  
25 nothing, there's no language where they are saying, well,

1 paired memory is somehow different from locally accessible  
2 memory, or if we can go back to the prior slide for a moment,  
3 for example, shared memory, so the spec. here actually refers  
4 to the possibility that you can have a design that includes  
5 shared memory, so you can have shared memory, you can have  
6 paired memory, you can have locally accessible memory, which  
7 may be paired, it may be shared.

8 The point, your Honor, is that there's no limitation  
9 on an execution unit is not limited to any particular kind of  
10:46AM 10 memory, it's just an execution unit. And that's clear both  
11 from the extrinsic evidence, the treatise we saw, as well as  
12 here in the spec. where it says that that's not a limitation  
13 of the invention, and so the fact that there are dependent  
14 claims that refer to locally accessible memory just simply  
15 confirm that the independent claim has to be broader, and  
16 they haven't offered any evidence from the spec. or expert  
17 declaration or extrinsic treatise evidence that would suggest  
18 that somehow paired memory is broader than the local  
19 accessible memory, or, for that matter, any support in the  
10:47AM 20 spec. for limiting the execution unit to one that has paired  
21 memory because they would be limiting it to, at best, it  
22 would be limiting it to a particular embodiment where the  
23 specification says that embodiment is not a limitation of the  
24 invention.

25 And with that, your Honor, unless your Honor has

1 questions on this term, I would move onto the last term that  
2 we'd be arguing.

3 THE COURT: Okay. Go ahead.

4 MR. BHANSALI: If we could go to slide 44, just  
5 briefly. So this next term is the "first input signal  
6 representing a first numerical value."

7 MR. HAYES: Your Honor, this is Hayes. To be fair  
8 to my Brother here, it appears he's going to run out of time  
9 in five minutes. I'm just going to give him a heads-up.

10:48AM 10 THE COURT: I've been interrupting him. Let's see  
11 how quickly you can get this done.

12 MR. BHANSALI: Your Honor, I'll be fairly prompt,  
13 but I, obviously, welcome the opportunity to answer your  
14 Honor's questions.

15 THE COURT: Understood.

16 MR. BHANSALI: So, there are two issues, your Honor,  
17 with respect to this term. The first issue is, and I think I  
18 mentioned that this also applies to the prior term, whether  
19 or not the LPHDR execution unit operates on values, numerical  
10:48AM 20 values, or whether it operates on signals.

21 Singular says they're relying on plain, ordinary  
22 meaning, but if you look at their briefing, and, in fact,  
23 Mr. Hayes' argument, they're suggesting that somehow the  
24 arithmetic operation is taking place on a signal, and then  
25 the second dispute is whether we should refer here to a

1 digital or analog representation to clarify what the signal  
2 is referring to.

3 So, turning to the first dispute, your Honor, this  
4 is just crystal clear from the specification that what the  
5 claim is referring to in the claim language is it's saying  
6 that there are arithmetic operations that are taking place on  
7 numerical values, and those numerical values are physically  
8 represented by a signal. That's the first input signal  
9 representing a first numerical value.

10:49AM 10 If we could go to the next slide. So, this we have  
11 four different citations from the specification here, all of  
12 which confirm that the arithmetic operations are being  
13 performed on numerical values. It refers to perform  
14 arithmetic operations on numerical values. It says that  
15 processing elements are designed to perform arithmetic  
16 operation on numerical values, the input values operated on  
17 by the processing element.

18 Take the form of electrical signals. This is what  
19 we're saying. There are electrical signals, but "the values  
10:50AM 20 are what are operated on," and then it says, "implementations  
21 may vary in dynamic range of space of the values that they  
22 process," but you don't have to just take our word for it,  
23 your Honor, Singular's own admissions show that they  
24 understand that actually the arithmetic operations take place  
25 on numeric values.

1           Let's go to the next slide, please. Here's an  
2           excerpt from somewhat Singular told the U.S. Patent Office in  
3           the parallel IPR proceeding just about a month, a little more  
4           than a month ago, February 24th, 2021:

5           "Moreover, whether the numbers are physically  
6           represented -- " physically represented. That's our signal.  
7           "-- using charges, voltages, various forms of spikes or other  
8           forms or a combination of digital and analog  
9           representations --" note that that language also follows our  
10:51AM 10          claim construction "-- has no bearing on the invention, which  
11          operates on the values represented, not their physical  
12          representation."

13           So what Singular is telling the PTAB in this  
14           statement, and, remember, under Federal Circuit precedent,  
15           this statement that they've made in the IPR is now part of  
16           the prosecution history of the patent, which the Court can  
17           take into account under the *Phillips* case to interpret the  
18           claims, they're saying the invention, the LPHDR execution  
19           unit, operates on the values presented, values represented,  
10:52AM 20          not on the physical representation, and they go on to say  
21          that the digital and analog representations are that physical  
22          representation. That's how we're proposing to construe the  
23          signal.

24           So, this statement that they made to the PTAB  
25          precisely confirms our proposed claim construction, and if we

1 could go to the next slide, please.

2 Not only that, but Singular admitted in its  
3 complaint in this case that the patent claims operation,  
4 arithmetic operations on numeric values. These are all parts  
5 of the claim that we've cited in our briefing.

6 Again, it refers to operation on an input numerical  
7 value. It refers to manipulating numbers, and, again, in the  
8 last bullet, it couldn't be clearer. Dr. Bates' LPHDR  
9 processing elements, frequently generate in response to  
10:53AM 10 request to perform arithmetic operations on high-dynamic  
11 range numbers, so, again, this is in their complaint, they're  
12 referring to the patent as requiring operation on numeric  
13 values.

14 Now, Singular, nonetheless, takes the position that  
15 we're somehow rewriting the claim and reading signals out of  
16 it, but the language that they cite from the spec., again,  
17 actually supports our interpretation, which if we could go to  
18 the next slide, which doesn't read signals out of the claim  
19 but puts them in the proper context which is that the signals  
10:54AM 20 are the physical representation, but it's the values that are  
21 being operated on, so this was language that Singular cited  
22 and Mr. Hayes referenced in his presentation, and it's the  
23 part at the end that he referred to, which is that it's  
24 saying that values take the form of electrical signals  
25 representing numerical values, but it's clear from the

1 context of this statement that it's talking about the  
2 arithmetic operations, and it's referring to the input,  
3 output and intermediate values that are received by, output  
4 by, and, importantly, for this claim construction, operated  
5 on by the PE, the processing element, so, again, the  
6 specification, the language that they're citing is saying  
7 that it's the values that are being operated on, and those  
8 values are represented by signals.

9 We're not reading the term signals out of the claim,  
10 we're simply saying that the signals are the physical  
11 representation, but it's the values that are operated on.

12 THE COURT: I'm struggling to understand what the  
13 point of this is or what you're even fighting about. I mean,  
14 I am very far from a person of ordinary skill in the art, but  
15 I read this, you know, a value is an abstract thing, the  
16 number 5, that's a value, it's abstract.

17 In a computer, that takes the form of an electrical  
18 signal, right, which is whatever it is, 101. I don't know  
19 how that's done, electrical charge or something, but that's a  
10:55AM 20 signal, and it represents a numerical value, which is 5, and  
21 I'm not sure what you're fighting about. I'm not sure what  
22 your construction adds to that.

23 MR. BHANSALI: Yes, your Honor. And I actually  
24 think the next slide may help to answer that question. So,  
25 the important thing here is that this first input signal

1 representing the first numerical value, that ends up being  
2 the antecedent to another part of the claim, so if we can  
3 show the highlighting here on this slide and the next one as  
4 well.

5 Okay. So we have the first input signal  
6 representing a first numerical value, and then there's a  
7 dynamic range of the possible valid inputs, so the possible  
8 valid inputs, the antecedent basis of that are the inputs,  
9 the input signals representing the first numerical value, and  
10:56AM 10 this is where the issue comes in because what we're saying is  
11 that those inputs have to be numerical values.

12 They can't be signals, and the reason for that, as  
13 we'll show on the next slide, is because the possible valid  
14 inputs, they're expressed in terms of a dynamic range of  
15 numbers, not a dynamic range of signals. And so for the  
16 claim to make any sense and for the fact finder to be able to  
17 determine whether or not the dynamic range is met and  
18 ultimately how the error is calculated, what we have to be  
19 looking at are numerical values that are being input to the  
10:57AM 20 arithmetic operation, not the physical signals that those  
21 numerical values are represented by.

22 So, if I could go to the next slide. So just a  
23 quick reminder of Mr. Kamber's tutorial, and your Honor said  
24 this a moment ago, so maybe I'm repeating it, so you've got a  
25 numerical value, and then that's represented by a physical

1 input signal.

2 So, if we posit a scenario where, as Singular seems  
3 to be suggesting, the arithmetic operation itself is being  
4 performed on an input signal, and if we could follow the bill  
5 there, we would basically be saying the dynamic range of the  
6 possible valid input signals to the first operation is at  
7 least as wide as 1 over 1,000,000 to 1,000,000.

8 Well, that doesn't make any sense because you can't  
9 express an input signal that way by describing it as  
10 1,000,000 to 1,000,000. By contrast, you can express a  
11 numerical value that way, and so if you take our  
12 construction, which is the dynamic range of the possible  
13 valid numerical values to the first operation is at least as  
14 wide as from 1 over 1,000,000 to 1,000,000, then that part of  
15 the claim makes sense.

16 So, your Honor, to answer your question as to why  
17 there's a fight here, it's because we think it's very  
18 important to understand that these inputs to the arithmetic  
19 operation are numerical values, they are not the physical  
20 representation because this part of the claim only makes  
21 sense if those inputs are, in fact, numeric values.

22 Now, if we could go to the next slide. And so they  
23 pointed to their expert's position about signals and values,  
24 but I want to just make one point here on the experts. Our  
25 expert was only opining on indefiniteness, and, notably, they

1 did not put in any expert declaration in the opening brief on  
2 this term. They only put in an expert declaration in the  
3 responsive brief, and so we did not then have a subsequent  
4 expert response to that, but I think the important point here  
5 is if you look at their expert's deposition testimony, he  
6 admits that 1 over 1,000,000 to a million is not something  
7 that he is saying is the input range of an input signal.

8 Again, that's just confirming that the way that  
9 dynamic range is described is actually the way you describe  
10 numeric values, not the way that you would describe the  
11 dynamic range of a signal.

12 If we could go to the next slide, please. This is a  
13 longer answer after he says, you know, that's not what he's  
14 saying, he kind of is saying a point that Google made about  
15 dynamic range, but he's making it clear that that point that  
16 he's refuting is actually not saying anything about the  
17 patent.

18 In other words, he's not in any way disputing that  
19 the claim language in the patent is expressing ranges in a  
20 way that relates to numerical values rather than signals.

21 And that really gets to one of the -- I think the  
22 key point here, your Honor. We're not disputing that  
23 numerical values in the claim are represented by signals.

24 There are --

25 (Court reporter couldn't hear)

1 THE COURT: I can hear you fine. Mr. Bhansali, why  
2 don't you back up a bit.

3 MR. BHANSALI: Yes, your Honor. I was just saying  
4 that we're not saying that signals are not part of this  
5 claim. In fact, we agree that signals are part of the claim,  
6 but the signals are used to represent referred to in the  
7 claim are, as the specification values, they're not the  
8 physical signals. That's not only what the specification  
9 says, but, as I said, is also what Singular told the patent  
10 office.

11:02AM

11 So, lastly, unless your Honor has more questions on  
12 this issue, I just want to turn to the last part of this  
13 construction, which is the language where we say that signals  
14 should be construed consistent actually with the position  
15 that Singular has taken as the digital and/or analog  
16 representation. That's the other part of this claim term.

17 And there, your Honor, all that we're doing with our  
18 construction is, again, clarifying the language that the  
19 signal is referring to the representation of the values, and  
20 in this instance, these are a digital and/or analog  
21 representation.

11:03AM

22 That's consistent with the specification. We have  
23 two places from the specification cited here that refer to  
24 implementation in digital or analog. There's some others  
25 that we cited in our briefing.

1           And, furthermore, Singular's only response to this  
2           is, well, Google would be improperly limiting the claim to  
3           some embodiments, but the problem with that position is they  
4           haven't identified any embodiment in the specification or  
5           that their expert has identified or that might exist that  
6           would be limited, that would be read out by our claim  
7           construction.

8           So, we're not actually excluding any potential  
9           embodiments, all we're doing is clarifying the language of  
10          the claim in a way that makes clear this very point that  
11          we've been talking about, the distinction between the values,  
12          which is what the arithmetic operation is performed on, and  
13          the signals, which are the physical input in the claim, and I  
14          would just say it's pretty ironic for Singular to be saying,  
15          to be opposing this part of the construction because they're  
16          on the one hand saying we're reading the word "signal" out of  
17          the claim, but then they're opposing this part of the  
18          construction, which actually sort of describes the signal in  
19          a way that's consistent with what the specification says and  
11:05AM 20          actually what they told the patent office in the excerpt from  
21          the IPR proceeding that we saw.

22                THE COURT:   Okay.

23                MR. BHANSALI:   With that, your Honor, I don't have  
24                anything further on these terms.

25                THE COURT:   Let me go back then to Mr. Hayes.   If

1     you think that you need more time than the time you have  
2     remaining, you can say so. One advantage of Zoom as opposed  
3     to getting on an airplane from San Francisco, it's not  
4     terribly inconvenient for us to continue this hearing. Today  
5     doesn't work, but, you know, either later this week or maybe  
6     spilling into next week.

7             MR. HAYES: I think, Judge, I can wrap it up pretty  
8     quickly.

9             THE COURT: All right, Mr. Hayes.

11:06AM 10            MR. HAYES: To start off, anyways, to start off a  
11     little bit where my Brother left off, we've got a lot to go  
12     over, but he keeps saying that he's not trying to read out  
13     the term, "signal." That is absolutely incorrect. The claim  
14     says, "A first operation on a first input signal,  
15     representing a first numerical value."

16            In his construction, if you adopt his construction,  
17     I don't get why they're doing this because the claim doesn't  
18     say a first multiplication on a value, it says a first  
19     operation on an input signal, which means you've got an input  
11:07AM 20     signal coming in and a bunch of things can happen to that  
21     signal before it's multiplied. That's exactly how it's  
22     claimed.

23            And if you look at, for example, Fig. 4, and Fig. 4  
24     is what the processor is. That's what the PE is and what it  
25     does, and they just don't go to the multiplier for

1 willy-nilly execution. They do other stuff, and that's  
2 exactly what he wants to change. He wants to say that  
3 there's no input signal, that what it really is, a value.  
4 The value skips right to the multiplier, and we don't do  
5 that. That's what you're going to hear, but that's not how  
6 it's written. I can say this forever, but if this isn't  
7 trying to rewrite the claim, nothing is.

8 And then if we could go to the argument, locally  
9 accessible, I don't think I have to spend much time on that.

11:08AM 10 We all know memory and locally accessible memory are  
11 different. One is local, one isn't. One could be somewhere  
12 that's not even in a room, and one could be right on the  
13 chip, whatever, so, I mean, that's not even a "issue" that  
14 they argue.

15 Then they argue this issue about the -- oh, it must  
16 cover, what did they say, it must cover a software. It  
17 doesn't cover software. This is a device, that's what it  
18 says, a device having what? A processing element. That's a  
19 thing.

11:08AM 20 The processing element having what? An input.  
21 That's a thing. The processing element having an output.  
22 That's a thing. And if you look at how you claim software,  
23 you say emulate all of that. Nothing of that nature is in  
24 there, so, I mean, that's just a few things.

25 And also one thing my Brother says, oh, we did

1 nothing inconsistent in the Patent Office. Give me a break.  
2 In the Patent Office, both of these terms are plain and  
3 ordinary. "Here, we're going to change the whole thing."

4 So, in that sense, Judge, they are rewriting. And  
5 another thing I'd like to bring up, I forgot the first time,  
6 if we look at slide 13 because sometimes this is interesting.  
7 If you see that, this is the final result --

8 THE COURT: Hold on, it's not up yet.

9 MR. HAYES: This is the final result of what their  
10 machinations do. It says, "Designed to perform arithmetic  
11 operations," perform, not execute, "arithmetic operations,  
12 not on signals on numerical values adapted to execute a first  
13 operation on a first input signal." That makes absolutely  
14 zero sense to begin with just from English.

15 No one is going to know even what it means, and  
16 that's why you don't rewrite a claim, real simple. That's  
17 why I submit it's plain and ordinary.

18 Now, if we go to his argument, the argument if you  
19 pull up again slide 19, this is their second attempt here  
11:10AM 20 that my Brother emulated. He's tried to say, oh, we're going  
21 to rewrite this term, and this is exactly -- you got the  
22 wrong thing. 19. Okay, here we go. Sorry.

23 Look at what we have here. They add analog to the  
24 claim. Analog is not in the claim. They add digital to the  
25 claim. They add and/or to the claim. They delete first,

1 they delete input signal. That's gone. They delete that the  
2 input signal is representative of anything, and they change  
3 signal to value.

4 This, again, is the same claim that they  
5 represented, which is an admission, to the patent office. It  
6 needs no construction. Come on. You can't rewrite the  
7 claim, and I think, Judge, that's about as easy to conclude  
8 as follows:

9 Now, before I get into repeated execution, which is  
11:11AM 10 the last thing, I would like to comment on a few of what my  
11 Brother said. Also, if we could pull up slide 19 of theirs,  
12 of Google's.

13 ( A recess was taken.)

14 THE COURT: Mr. Hayes. And, again, if you need more  
15 time, I'll give it to you.

16 MR. HAYES: Are we going to 12?

17 THE COURT: Again, I've got a call with about 1,000  
18 people starting at 12, so how about 11:50?

19 MR. HAYES: Okay, I can do that. Anyways, claim 19,  
11:17AM 20 my Brother puts that up as an analog signal. That's not an  
21 analog. They withdrew that. If you look at the patent and  
22 specifically column 14, lines 58 to I believe 60, 59 and 60,  
23 they're talking about an analog, typical analog signal itself  
24 modulates and then comes to stability over time period before  
25 it's even, before you even start going in and taking the

1 statistical mean thereof.

2 It doesn't vary like this. If it varied like that  
3 and that thing to the right was a TV, nothing would work,  
4 your phone wouldn't work, nothing would work. If you look at  
5 the column 14, yeah, I bring it up now, but 59 and 60,  
6 they're talking about the variants of the signal  
7 approximately 1 percent. That's hardly 1 percent. That's  
8 just makeup to extend it.

9 Next my Brother uses -- you can take that off. Next  
10 my Brother uses -- you can take that off. Next, my Brother  
11 uses a slide, we'll just say, oh, this is heat. Who cares?  
12 If it's hot, you left your phone out for two days and it  
13 doesn't work, so what? We're talking about workable signals,  
14 et cetera, and so, I mean, that has nothing to do with the  
15 price of bread.

16 Let me see what else. If we look at slide 29, if  
17 you look at slide 29, they spend some time on that saying,  
18 oh, our expert confessed to something to that effect about  
19 fluctuation. That's cropped, Judge. Both of those two  
11:19AM 20 portions of the declaration are cropped.

21 In fact, if you read the next sentence on 33, it  
22 either goes along, it explains how it comes down to a stable  
23 situation that anybody who took second year calculus with a  
24 little statistics can figure out. The same thing here on the  
25 bottom line, 34, that's grossly cropped. The "... " is

1 exactly opposite what they cited it for, and I point that out  
2 just simply because, you know, this is a consistent way, I  
3 can't go through every single thing that they cropped, but I  
4 think a few uncrops, a few cropped will sort of make my  
5 point.

6 Then someone said that, oh, there's no support in  
7 the spec. for the law of large numbers. Of course, there is.  
8 It says the idea is they get a statistical mean. A  
9 statistical mean by definition in a situation such as this  
10 where they are doing one billion executions a second is a  
11 statistical. I mean, the law of large numbers is exactly how  
12 you do it.

13 THE COURT: But that's the question, right, I mean,  
14 it gets back to repeated execution. Are we talking about a  
15 billion or a trillion or are we talking two or three?

16 MR. HAYES: No, we're not talking about any number,  
17 per se. You can't have a specific number. Why? Because all  
18 of the systems are different, all of the perturbations are  
19 different, and analog signals are going to have a different  
20 analog signal. The idea, if you do repeated executions, as  
21 we put in the declaration, pursuant to the law of large  
22 numbers, which, indeed, then flattens out exactly at a  
23 number, and that's exactly why if you look at the claim,  
24 you're not comparing an exact number to a number, a result.  
25 You're comparing to a statistical mean that is representative

1 of the population. That's the way it works.

2 And to sort of put that to bed, let me just show  
3 you.

4 THE COURT: But what you're saying is that a person  
5 of ordinary skill in the art would read that and interpret it  
6 as such, right?

7 MR. HAYES: Absolutely, Judge, and, by the way, in  
8 my slides. Go to slide 25. Slide 25, all of these, what I  
9 just said there, are all supported in spades by our expert's  
10 declaration, and, interestingly, their expert, who they put  
11 their thing and doesn't even mention the words "statistical  
12 mean."

13 What he does is take the average, the average of 10  
14 perturbations, right, and then divides, et cetera, to get an  
15 average. That is like saying this is a sytem that's  
16 operating at illiops a second. That's like saying I want to  
17 count everybody in China, and we're going to figure out how  
18 tall they are on average. We're going to take the first 10  
19 guys off the street and a few women, and, boom, that's the  
20 answer.

21 And that is, as my expert said, not only absurd but  
22 is technically incompetent basically, and to do that, you've  
23 got the next one, 25.

24 Yes, 26, and this right there, I won't go through  
25 it, but that's the law of large numbers, et cetera, but

1       that's unrebutted, unrebutted, period.

2               Next slide 26, same again, what a person of ordinary  
3       skill in the art would understand. Same again, unrebutted  
4       expert testimony as opposed to what do we have, attorney  
5       argument on one side, and the notion that they couldn't have  
6       submitted an expert report, sure, they could. All they had  
7       to do is ask leave to do it.

8               But, in any event, the next one, the next slide,  
9       this is, again, unrebutted, taking the average of a few  
11:24AM 10       samples, well, I guess Lee thinks that's okay.

11              And, anyways, if we look at slide, 28 okay. Now we  
12       get down to the nitty-gritty. The first thing that Google --  
13       the reason their argument is technically erroneous is they  
14       ignore the term "statistical mean." That's in the claim,  
15       it's not arithmetic average.

16              One skilled in the art would not think they're going  
17       to rely upon a number on that red box. Come on, do you know  
18       how long it takes to get that graph run where you get a flat  
19       statistical mean under the yellow box? That's less than one  
11:25AM 20       millionth of one second, period, and on the left, it is  
21       irrelevant. On the right is what one skilled in the art  
22       figures out. That's exactly how it's claimed.

23              You don't have to know that it's Number 12023 and  
24       put that in the claim. If that's the case maybe, what, one  
25       human alive would have traced, so to speak. That's not how

1     you do statistics, and that's what they ignore. They ignore  
2     both of those, and as we can see, Judge, this happens here  
3     over and over, and the law of large numbers, that's like  
4     saying, oh, there's no support. Of course, there's support  
5     for the word "statistical," and we gave the definition of  
6     "statistical," et cetera. But that's like saying there's no  
7     support for a mechanical case, F equals MA, there's no  
8     support for gravity.

9             This has been around since I -- of course, it's been  
11:25AM 10     awhile -- went to engineering school, and our position is  
11     relatively simple. It's that one of ordinary skill in the  
12     art, who obviously would have taken, gone to college, would  
13     be an engineer, he would at least have taken a basic  
14     statistic course showing the law of large numbers, and he  
15     would be able to determine the statistical mean in  
16     one-millionth of a second, assuming, you know, assuming that  
17     he didn't skip that class.

18             But, in any event, then I want to give you this.  
19     Judge, the reason I put this in is to just show you how one  
11:27AM 20     of ordinary skill in the art would determine infringement,  
21     that it's not indefinite, it can be done ASAP. Let's assume  
22     now, if you can see, the red blocks are just multipliers in  
23     the system. You got A and B going into the blocks. Out  
24     comes the first answer, let's assume it's an analog signal,  
25     as they say, and it's 4.1. The next one, you do the same

1 thing, and what is it, 4.3. The next one and the next one,  
2 and you get down to like A4, and it's C, 4.34, so you do  
3 that, and what you do is you do it pursuant to law of large  
4 numbers, if that's what you've been taught, and what do you  
5 get, you get a statistical mean at approximately 4.2. That's  
6 what you get.

7 Now, how do you know if it infringes or it doesn't  
8 infringe? Well, the first thing you do, according to the  
9 claim, is you multiply 2 times 2 because that's the exact  
11:28AM 10 mathematical input. You got the 4. Then you take the 4.2,  
11 which is the statistical mean, you subtract from it the 4,  
12 and you get .2, and then that is 5 percent, so that  
13 calculation is wrong. It's off by 5 percent.

14 All right. You know that. Then what you do is you  
15 repeat and do this. Is there another slide? Then what you  
16 do is you repeat this for all valid inputs, right, and then  
17 at the end of the day, if 5 percent of the executions are  
18 mathematically wrong by at least 5 percent, then you  
19 infringe. That is exactly how it's done. That's exactly how  
11:29AM 20 it's done in the complaint, by the way, et cetera, and this  
21 is it.

22 Anybody skilled in the art could do this without any  
23 concern, and now, Judge, I think with all due respect,  
24 hopefully you'll have time for lunch.

25 THE COURT: All right.

1 MR. HAYES: Thank you.

2 THE COURT: All right. Thank you. Do you want to  
3 do a quick response of any kind, I guess, Google, rather than  
4 naming any of the three lawyers, do you want to do a quick  
5 response?

6 MS. YBARRA: Yes, your Honor, I think I can do my  
7 response in about 10 minutes, if that's okay with, so you can  
8 have time for lunch.

9 THE COURT: All right.

11:29AM 10 MS. YBARRA: So, starting with a couple of points  
11 that Mr. Hayes made, he said Dr. Wei doesn't mention  
12 statistical mean in his declaration. That's not so. Dr. Wei  
13 discusses how the statistical mean overrepeated execution is  
14 indefinite, and Mr. Hayes said statistical mean, anybody  
15 would know what that means. That's not accurate either.

16 Dr. Khatri was asked multiple times in his  
17 deposition whether statistical mean differed from arithmetic  
18 mean in any way, and he refused to provide an answer and then  
19 said it was outside the scope of his opinion, and that's his  
11:30AM 20 testimony on that point is Exhibit A to our supplemental  
21 claim construction brief at page 54, line 6 through 25.

22 If we could pull up, Matthias, the last slide of our  
23 deck, Dr. Khatri's declaration at paragraph 34 that Mr. Hayes  
24 was just discussing. This is the graph as it's presented in  
25 Dr. Khatri's declaration, and he says the red box is meant to

1 zoom in on the graph below, and that graph plus the results  
2 of repeated execution of a multiplication operation, 2 times  
3 1, and the blue line shows the average of the output value,  
4 and, Matthias, if we could do the animation there.

5 We were just kind of zooming in on Dr. Khatri's own  
6 figures here. I think there's one more animation there.  
7 This is in Google's rebuttal slides.

8 MR. HAYES: There is no animation. You didn't send  
9 an animation to us, counsel.

11:32AM 10 THE COURT: Well, let's see it.

11 MS. YBARRA: All of the visuals are depicted on the  
12 slides that we sent you, but on the left side of the graph,  
13 the arithmetic average of the output is unstable and  
14 fluctuates significantly over short periods of time, as shown  
15 in the red box.

16 This is Dr. Khatri's language. This is from his  
17 declaration, and he says it begins to stabilize, the average  
18 begins to stabilize with more repeated executions of that  
19 single operation.

11:32AM 20 So as you move to the right, more time has past and  
21 more executions of the execution are repeated, and he says  
22 the magnified portion of the graph in the yellow box on the  
23 right represents the statistical mean over repeated execution  
24 were cited in the claims. So he says on the left side,  
25 that's not the stable statistical mean; on the right side, it

1 is.

2 But to be clear, it's not that the noise stabilizes,  
3 it's not that the noise flattens out, all Singular is saying  
4 is once you have a large enough number of samples, additional  
5 repeated executions are not going to impact the average, and  
6 that's just the law of large numbers, but the processor  
7 itself, the device itself is not stabilizing.

8 And every part of the blue line here reflects the  
9 statistical mean of a repeated execution, and that line  
10 drifts above and below the error threshold claimed by claim 1  
11 of the '273 patent, which is the example we're using, and I  
12 think if you could do the last animation, Matthias. That is  
13 in this calculation of 2 times 1, the error threshold would  
14 be at 2.001.

15 And you can see there's a difference between the  
16 left and the right whether you are falling above or below the  
17 line. Dr. Khatri says ignore the left part of the line,  
18 ignore everything in the red box. He says it's only what's  
19 in the yellow box that's on the right side of the box that  
20 counts. Only this is the claimed statistical mean, and you  
21 just heard Mr. Hayes repeat the same thing that the left side  
22 of the graph is irrelevant, but that's just based on  
23 Dr. Khatri's opinion but nothing else. He can't point to --

24 THE COURT: I think, if I understand the argument  
25 right, he's saying it isn't just his opinion but this is what

1 a person of skill in the art would understand that you don't  
2 look at the red box, you need to get to the yellow box. It's  
3 not his personal opinion, I think, I mean, I have to go back  
4 and look at it, I think that was the point that he's saying  
5 that a person of skill in the art would understand.

6 MS. YBARRA: He is saying a person of skill in the  
7 art would understand that, but that's not enough. He can't  
8 come in and make that statement without pointing to any  
9 objective guidance in the specification just say, and we cite  
11:35AM 10 case after case in our briefs for that very proposition.  
11 It's not sufficient for him to say -- the specification has  
12 to give guidance to someone else looking at this to know what  
13 the scope of the claim is, and the blue line is the  
14 statistical, it represents the statistical mean of repeated  
15 execution all the way through, not just on the right side.

16 A different person of skill in the art might  
17 conclude that the statistical means stabilizes, or as  
18 Dr. Khatri refers to it, ceases to fluctuate significantly or  
19 doesn't meaningfully fluctuate at a different point than the  
11:36AM 20 yellow box on the right.

21 Someone else might conclude it happens towards the  
22 right side of the graph in the red box, which is flattening  
23 out there as well. Dr. Khatri says that this graph  
24 demonstrates the lack of a need to identify the precise  
25 number of executions necessary to ascertain the claims of

1 statistical means, but actually it just shows the opposite:  
2 How does one skilled in the art know at what point on the  
3 graph the statistical mean has stabilized? That's our whole  
4 point. There's nothing in the intrinsic evidence, looking at  
5 the intrinsic evidence record that provides any guidance  
6 about when you've reached stabilization. Is it, you know,  
7 the right side of the red box? Is it the yellow box? Is it  
8 somewhere in between because the line on Singular's graph, if  
9 you look at Dr. Khatri's chart, is flat for most of the way  
10 through.

11 One other point on this, and then I want to go to the  
12 last slide that Mr. Hayes had pulled up. Paragraph 36 of  
13 Dr. Khatri's declaration, he acknowledges that the line will  
14 not always flatten out in all circumstances. He implicitly  
15 concedes that heat is generating noise, the line won't flatten,  
16 the average won't stabilize, but he just dismisses that by  
17 saying, well, that device that produced such a result wouldn't  
18 be useful, which is not really helpful here.

19 If we could go to the last slide that Mr. Hayes was  
20 just looking at, and this was in Singular's deck, and I'll be  
21 brief here. First of all, this blue box here and the text in  
22 the blue box is incorrect insofar as it's tended to reflect  
23 the claim language. The blue box says it's 5 percent of all  
24 executions are mathematically wrong by .05 percent, the  
25 device infringes. That's not what the claims say. The

1 claims say for at least 5 percent of the possible valid  
2 inference to the first operation, the statistical mean of a  
3 repeated execution must differ from the exact mathematical  
4 result by at least .05 percent.

5 I just want to clear that up, but this chart also  
6 really illustrates Google's point on indefiniteness.

7 Mr. Hayes says that he uses four different examples of an  
8 operation and then gets to end. An end here is doing all of  
9 the work. Whether or not the claim language is met will  
10 depend on N, and Singular shows you four calculations and  
11 then says after doing enough, you arrive at 4.2, which is  
12 presumably the stable statistical mean, but we saw with  
13 Dr. Khatri's testimony, he can't tell us how to figure out N,  
14 how many repeated executions does one need to perform.  
15 There's no objective guidance anywhere in the patent record  
16 on that and none on this slide either. I think that is all  
17 from us --

18 THE COURT: Okay.

19 MS. YBARRA: -- unless you have any further  
20 questions.

21 THE COURT: All right. Mr. Hayes, last word.

22 MR. HAYES: Yes, your Honor. If you can pull up  
23 that slide that my Sister just referenced. She indicated all  
24 we did is take four numbers, et cetera. This is an example,  
25 obviously, A to the N does not -- it means it just keeps

1 going.

2 Secondly, the blue box is not incorrect, it says  
3 repeat for all valid inputs, so that's a misstatement.

4 Third, when she keeps talking about Dr. Khatri and  
5 our expert, your Honor, I just suggest that the clerk read  
6 the quotes that she quotes because, believe it or not, 90  
7 percent are indeed miscited.

8 Now, if you can give me the slide before that. Your  
9 Honor, I really believe that one of ordinary skill in the art  
11:40AM 10 would not, even Dr. Wei would not assume over there on the  
11 far left red box where it's bouncing around like that is a  
12 statistical mean of anything, and, frankly, if you look at  
13 what he did there, his calculations probably don't even get  
14 past the red line.

15 Don't forget, he did eight of them, and you can do  
16 1500 one millionth of a second. I mean, I just think the  
17 argument that was made, now, from a factual point of view,  
18 his graph, as in the declaration of our expert, is exactly on  
19 the exact parameters given by Dr. Wei. The only difference  
11:41AM 20 is it complies with the law of large numbers and then  
21 generates a statistical mean as such. That's it, Judge,  
22 thank you.

23 THE COURT: All right. Thank you. We'll pause  
24 there. I know that sometimes after a Markman Hearing, the  
25 parties want to do follow-up, you know, supplemental

1 briefings either to correct or to respond to something. I  
2 will permit that, but let's get that in let's say close of  
3 business a week from today, and I won't limit you. If you  
4 think you have something to say, I'll let you say it. You  
5 won't have to file anything. I won't put a page limit on it,  
6 but remember the first rule, which is to have mercy on the  
7 Judge and the law clerk, but I'll give you that opportunity  
8 to respond if you want to take it or correct something,  
9 supplement something, what have you. Thank you. This has  
10 all been very helpful, well argued, and unless there's  
11 anything further, we'll stand in recess. Thank you.

12 MR. BHANSALI: Thank you very much, your Honor.

13 MR. HAYES: Thank you, your Honor.

14 THE COURT: Thank you.

15 (Whereupon, the hearing was adjourned at 11:42 a.m.)  
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C E R T I F I C A T E

UNITED STATES DISTRICT COURT )  
DISTRICT OF MASSACHUSETTS ) ss.  
CITY OF BOSTON )

I do hereby certify that the foregoing transcript,  
Pages 1 through 85 inclusive, was recorded by me  
stenographically at the time and place aforesaid in Civil  
Action No. 19-12551 -FDS, SINGULAR COMPUTING LLC vs. GOOGLE LLC  
and thereafter by me reduced to typewriting and is a true and  
accurate record of the proceedings.

Dated April 3, 2021.

s/s Valerie A. O'Hara

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VALERIE A. O'HARA

OFFICIAL COURT REPORTER